

Beef production from the dairy herd




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Beef production from the dairy herd

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HISTORY OF DAIRY CATTLE AS MEAT-PRODUCING ANIMALS

Until the end of the 19th century and the beginning of the 20th, bovine meat in Canada was produced primarily by three British beef breeds — Hereford, Angus, and Shorthorn. The animals were raised and finished mostly on grass plus preserved forages and were slaughtered when they reached 600–900 kg at about 4–5 years of age. This practice gradually changed over the years, so that beef cattle are now raised to about 270–400 kg on grass and finished to 445–550 kg in feedlots, where the major portion of the feed consists of concentrate.

At present the beef industry is once again investigating the prospect of finishing cattle by using higher proportions of roughage in the finishing ration. As usual, the exact type of finishing rations used is governed by economic conditions. When the price of beef is depressed and the cost of grain is high in relation to forages, more emphasis is placed on forage finishing of beef. The future will also likely see considerable emphasis on the utilization of “opportunity feeds” such as forestry waste products, poultry manure, cannery waste, and cull horticultural crops for finishing beef cattle. For more information on waste feeds, consult the publication entitled *Guidelines for Feeding Potato Wastes* (Nicholson 1974).

Beef cattle production in North America relies heavily on vast rangelands that are unsuitable for crops. Dairy cattle, on the other hand, are subjected to much more intensive year-round rearing and feeding conditions. Consequently, the beef and dairy industries in North America have developed as two distinct entities. For beef breeders the ideal beef animal is short-legged, square, blocky-framed, and early maturing, whereas the dairy farmer breeds for a tall, long-legged, angular, and later maturing animal, with emphasis on milk production. Beef industry personnel have interpreted these differences to mean that the dairy animal is inferior as a beef producer. Research has shown that although distinguishing characteristics do exist, such as differences in weight at the same chronological age and more internal offal fat in the dairy breeds, these differences have no bearing on the quality or yield of the carcass. In fact, for years the surplus males from the dairy herd, about 25% of calves born in Canada, have been accepted for the production of high-quality veal. In addition, all dairy females end up in the meat trade, making up about 30–40% of the total beef supply, largely in the form of manufacturing beef or hamburger.

Many reports on the possibility of using dairy steers to produce counter beef (steaks and roasts) have been written over the years. The first major large-scale effort demonstrating the possibility of producing beef from the dairy animal took place in the United Kingdom in the 1950s. The location is not surprising, because the U.K. does not have extensive rangelands for beef production and is much more dependent on imported beef than is Canada. Researchers in the U.K. therefore decided to attempt to replace some of their imported beef with meat from surplus males of the Friesian breed. They demonstrated that beef of excellent quality weighing about 400 kg could be produced from Friesian steers raised in confinement from birth to slaughter on a ration consisting of 85% barley and 15% supplement, which provided additional protein, minerals, and vitamins. Since this work, numerous research reports on the successful production of beef from the dairy male have been published in Canada and abroad.

Two highly significant changes have occurred recently in the Canadian beef industry. First, the importation of foreign breeds of cattle into Canada, beginning in 1967, led to the establishment of 60–70 new breeds of beef cattle in Canada, with the greatest proportion of cattle coming from Western Europe. Second, in 1972 Canada changed its beef-grading standards. The two most significant changes in these grading standards were the requirement that carcasses be ribbed between the 11th and 12th rib portion of the carcass so that the actual depth of fat could be measured; and that the most desirable carcass would weigh 272 kg (plus or minus 45 kg) and have 0.5–1.4 cm of subcutaneous fat at the rib section. These standards were changed again in September 1984, and carcasses are now ribbed between the 12th and 13th rib, as is normal practice in the United States.

A major difference between many of the new breeds of beef cattle and the established Canadian breeds is that the new breeds have higher mature weights. They are thus physiologically younger and carry less fat at the same slaughter weights than do the established breeds. In this characteristic they resemble the Canadian Holstein-Friesian. The revised grading standards have been beneficial to breeders of the Holstein-Friesian in that many more carcasses of these animals now qualify for the top grades, A1 and A2. Selection to conform to the new grades within the established breeds has also been beneficial because it has reduced the level of waste fat on finished carcasses.

This publication provides information on methods of producing beef from the dairy herd, based on work that was carried out in Canada between 1960 and 1985.

CALVES

Obtaining calves

Producer retained

Milk producers may keep the calves born to their cows and raise the males through to market weight. From a health point of view, this is highly desirable. It ensures that the calf obtains the best postnatal treatment, such as being fed colostrum. In addition, calf mortality is usually lower for calves that remain on the home farm. Many dairy farmers, however, prefer to expand their milk-producing capacity rather than extend their operation into the growing and finishing of beef. These dairy farmers would rather dispose of their males as quickly and as profitably as possible through private sales or local auction barns.

Contract buying

A growing and finishing operator often has a contract with a dairy farmer to raise calves to a specific weight or age (preferably after weaning). The current value of newborn calves and the cost of labor and feed should make it possible for the operator and the dairy farmer to negotiate a satisfactory price periodically. With this system of raising dairy beef, the animals are subjected to only one stressful situation, transportation.

Specialist buying

A specialist in raising calves may obtain young calves directly from dairy farmers (or sale barns) and raise them under carefully controlled conditions for sale as veal or as growing and finishing beef animals. Once calves are weaned and are on dry feed, they are less susceptible to disease. However, even after weaning, transportation stress can result in shipping fever and pneumonia. A calf specialist often continues feeding calves to beef market weights.

Auction buying

For many dairy farmers, the most common way of disposing of surplus males is through the local sale barns, shortly after birth. This means of disposal makes available large numbers of calves each week, although seasonal variations do occur. The selling of calves in this way carries the risk of exposing them to disease when their resistance is lowest. Stress of moving, chills from cold and drafts, dampness, and temporary lack of food make the young calves susceptible to severe health problems, which can result in increased costs because of medication, delayed growth, and death. If calves are purchased through this system, it is advisable to isolate them from other calves before adding them to the main herd, to ensure that they are healthy and no longer require medication.

Raising calves

Health of newborn calves

The most serious concern of the dairy-beef operator is the health of young calves. Until they are 3 or 4 weeks old, their only immunity is provided by colostrum from the dam. Research has shown that a calf must receive colostrum within 12 hours of birth if it is to acquire passive immunity to disease. Unfortunately, except for a slight general immunity afforded by proteins in the blood of the calf, colostrum transfers specific immunity only to diseases the dam has contracted. Consequently, a calf removed from its home environment and exposed to other sources of disease has little protection. As well, the stress of moving, combined with exposure to cold, drafts, and dampness, also adds to the difficulty of rearing sale-barn calves. Some death losses are inevitable. With the best possible care, death losses usually range from 4 to 5% and occasionally reach 15%. Pneumonia, concomitant scours, and blood poisoning are common causes of death.

Precautions, procedures, and recommendations for raising calves

- Select only strong, healthy calves. Animals under 40 kg usually have more health problems. Be sure the navel is not swollen. Do not buy calves that have scours, stiff legs, or mucus in their nostrils, or that breathe rapidly.
- Keep calves warm and dry. If the temperature in the calf house cannot be kept at 15–21°C, install a heat lamp for each calf. If calves are raised in bedded pens, do not allow bedding to become wet.
- Provide individual pens or tie stalls during the first 5–8 weeks to minimize the transfer of disease between calves.
- Provide ventilation, using a thermostatically controlled fan to give each calf about 23 dm³ of air per second. Slotted air inlets at ceiling level are usually best for supplying fresh air without drafts and allowing the fresh air to warm up before reaching the calf.
- If scours occur, feed only half the amount of milk or milk replacer but make up the difference with an equal amount of water. Electrolytes may also be fed to prevent severe dehydration.
- Use a rectal thermometer to take the temperature of each calf when it arrives; every second day during the first week; and thereafter if the calf breathes rapidly, has mucus in its nostrils, or has severe diarrhea. If calf temperature is above 39.7°C, consult your veterinarian.
- Do not allow young calves to become dehydrated by severe or persistent diarrhea, because this condition makes them extremely susceptible to respiratory infections. Early diagnosis and treatment are important; therefore consult your veterinarian before problems become severe.

- Provided the calf is healthy, dehorning and castration should be carried out at 3–6 weeks of age. The older the calf is, the more severe the setback. Of the several methods available, dehorning with an electric iron and castrating with elastrators or by surgery seem to attain the desired results with a minimum of discomfort or reduced growth on the part of the calf.
- An alternative to raising calves in confinement is hutch rearing. A number of dairy farmers who have calves with health problems have used this system successfully. An enclosed bedded area is used (approximately 122 × 122 × 122 cm), open on one side and having a small exercise area enclosed in mesh wire. With this method of management, calves appear to suffer few health problems even in subzero temperature. Hutches should be portable so that they can be moved periodically to prevent a buildup of pathogenic bacteria.

Feeding young calves

Whenever possible, first choice should be given to obtaining colostrum-fed calves. Whole milk is still the most desirable calf feed, but satisfactory results can be obtained by using commercial milk replacers. When feeding milk replacers, follow the manufacturer's directions. When selecting a particular brand, keep in mind that replacers with higher fat levels and lower cereal-product content are usually associated with better performance, but they are more expensive. Animal by-products are more readily utilized by the young (nonruminating) calf.

A good-quality calf starter should be available to the calf from the first week. The starter listed in Table 1 produced excellent results with Holstein calves. Commercially available calf starters are usually as effective and are more economical than a custom-mixed formulation. Custom mixing is not recommended unless

Table 1. Holstein beef rations.

	Starter (parts per 1000)	Grower–Finisher (parts per 1000)	Premix (parts per 100)
Barley	400	500	—
Oats	230	250	—
Bran	100	100	—
Soybean meal	100	90	97
Dehydrated alfalfa	100	—	—
Premix	40	30	—
Bone meal	20	20	—
Salt	10	10	—
Vitamin A (10 000 units per gram)	—	—	2
Irradiated yeast (170 000 units of vitamin D per gram)	—	—	1
Total	1000	1000	100
Approximate crude protein (%)	15.8	14.1	

the calf operation is large enough to warrant ordering feed in 5-tonne batches or larger.

Experience has shown that a calf that begins consuming grain early and continues to increase consumption throughout the milk-feeding stage usually performs better and suffers the least setback, regardless of whether it is weaned abruptly or gradually. Because milk or milk replacers are usually more expensive than dry feeds, early weaning (3–6 weeks) should be practiced. Hay feeding during the milk-feeding stage is optional. However, if the calves are to be turned out on grass or fed on other forages after the weaning stage, hay should also be offered free-choice as soon as possible. This hastens the development of the rumen to the stage where forages can be fully utilized.

Some calf growers have resorted to group feeding with mechanical feeders. Several types are available on the market. The feeders mix a fixed quantity of milk replacer and warm water at definite intervals and deliver the mixed feed to a nipple or nipples for the calves. This system saves considerable labor but does result in more health problems than does individual feeding.

Other feeds such as sour colostrum, whey, or skim milk have been used to feed dairy calves successfully. Further information on feeding and caring for dairy calves can be found in the Bibliography.

STEERS

Regimens for raising steers

Dairy steers can be raised for slaughter under a variety of nutritional regimens, ranging from extensive (forage only) to intensive (concentrate only). An intermediate system encompassing both forage and concentrate feeding has been developed by researchers at the Lennoxville Research Station (see Appendix). At Agassiz, experiments have been carried out to examine the growth and carcass characteristics of steers slaughtered at various weights ranging from 161 to 835 kg liveweight, primarily with the use of high or all-concentrate rations. These experiments also evaluated the use of hormones for improving growth rate and carcass quality in both Holstein bulls and steers (see section entitled “Effect of hormone implants”).

Feedlot infections and functional diseases

With steers as with calves, animal health is of prime importance. In dairy-bred animals, mainly Holstein-Friesian steers, few disorders occur after the animals are on dry feed and weigh over 130 kg, provided they are not subjected to adverse environmental conditions. Poor ventilation, high humidity, or wet bedding may increase the frequency and intensity of disease outbreaks. As soon as an individual animal exhibits abnormal behavior, it should be removed to an isolated sick bay area and provided with the appropriate medical treatment. It is essential that test steers be observed continually for health conditions so that financial losses through

death or prolonged sickness are minimized. The earlier abnormalities are observed and treated, the greater the chances are for recovery.

The incidence of bloat increases with the feeding of all-concentrate rations. This occurrence can be minimized by offering roughages such as hay or silage in addition to concentrates. Rumenitis can also occur if animals are subjected to all-concentrate feeding for extended periods. Steers tend to alleviate this condition by consuming a portion of their fresh bedding, even if it consists of shavings. Although it is possible to raise steers from weaning to slaughter on all-concentrate rations, this practice is not generally recommended unless the price difference between grain and roughage is exceptionally small. Maximum rates of gain are not usually depressed by feeding up to 40% of the ration as high-quality roughage.

Occasionally an animal may become lame from founder or laminitis caused by digestive upset resulting from, for example, the overeating of concentrate. This ailment does not usually cause death but may reduce feed intake and rate of gain. If the condition persists, the elimination of seriously affected animals is recommended.

The incidence of condemned liver resulting from abscesses in Holstein steers is generally low, amounting to less than 5% of cattle slaughtered. This disorder may originate when rations are changed abruptly. Groups of beef steers have been known to have 70–80% of their liver condemned at slaughter after being moved from expansive rangeland to confinement finishing in a feedlot. Other stress factors such as shipping, frequent handling, fighting, crowded conditions, or a strange environment can increase liver abscesses in feedlot cattle.

Particular attention must be given to levels of vitamin A and possibly vitamin D when high- or all-concentrate rations are fed. In one feeding experiment, a few Holstein steers and bulls being fed an all-concentrate ration exhibited severe periodic convulsions and varying degrees of blindness. Other conventional disorders of vitamin A deficiency such as excessive lacrimation, diarrhea, nasal discharge, and pulmonary problems were not evident. Injections of vitamin A halted progressive blindness and eliminated convulsions. At no time before or after treatment in this experiment were feed consumption or rate of gain affected.

Efficiency changes during growth

In normal circumstances, efficiency, defined as units of feed required to produce a unit of gain in weight, increases from birth until an animal reaches its mature weight. The major cause of this constant increase is maintenance cost and increasing fat deposition. Obviously, a 500-kg steer has 10 times as much body mass to maintain as a 50-kg calf, and consequently the cost per kilogram gained is considerably higher for the 500-kg steer than for the 50-kg calf. This relationship is shown in Table 2. A 260-kg steer required 4.56 kg of total digestible nutrients (TDN) per kilogram of gain, and a 620-kg steer required 7.64 kg of TDN. Part of this difference can be explained by the fact that the heavier steer deposits more carcass fat than the lighter one. All steers in the experiment reported in Table 2 received a combination of grower ration (Table 1) and hay plus beet pulp during the final 100 kg of finishing growth.

Table 2. Growth and feed efficiency of Holstein steers.

Growth interval (kg)	Gain per day (kg)	Feed per day (kg)	Concentrate (%)	TDN per kg of gain* (kg)
45–160	0.72	2.84	53	2.75
180–340	1.23	8.59	58	4.56
360–520	1.27	11.64	57	6.33
545–700	1.12	12.41	60	7.64
725–840	0.81	11.86	64	9.69

* TDN = (0.5 × hay) + (0.75 × concentrate).

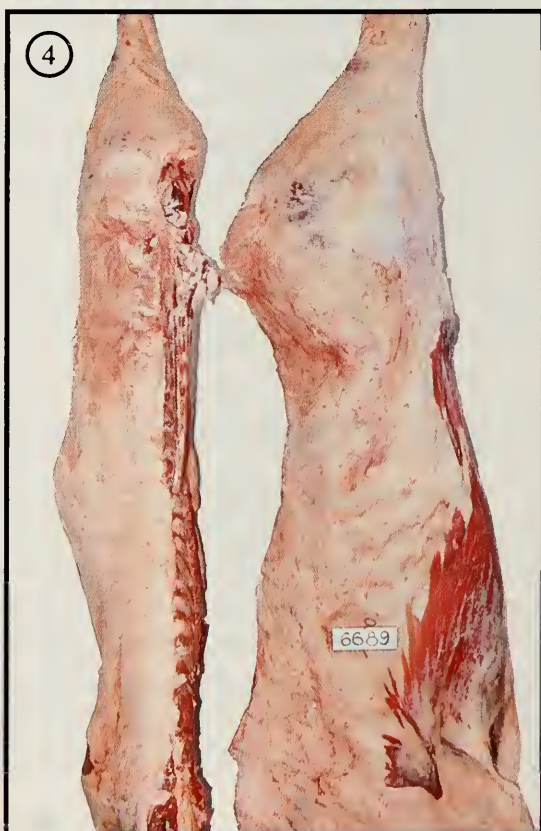
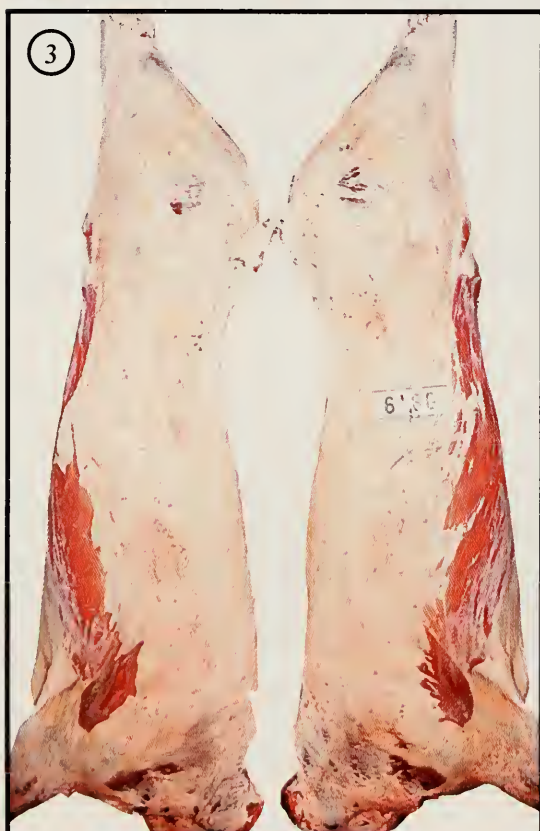
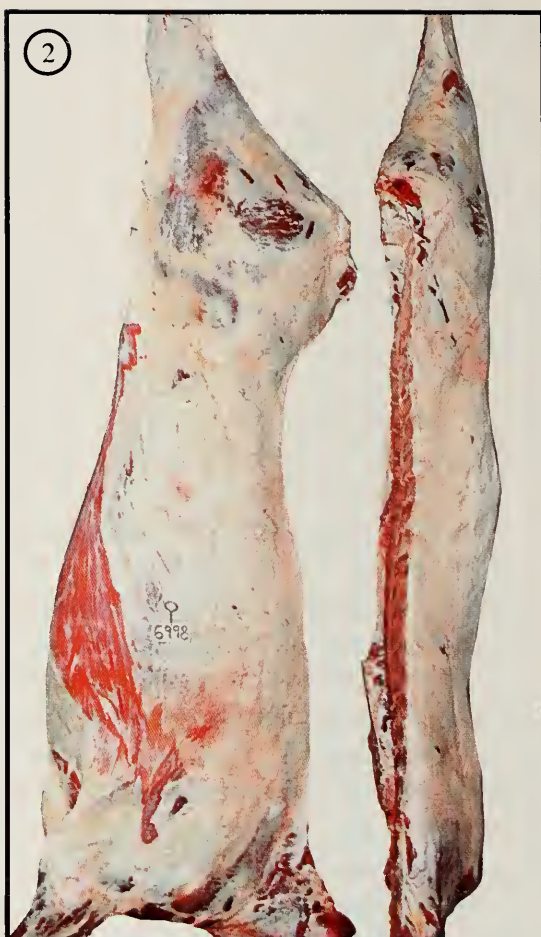
Table 2 also shows that growth rate is sigmoidal, or S-shaped, over a long-term growth period. At about 100 kg, the rate of growth is 0.72 kg per day; from 180 to 700 kg, the rate goes from 1.23 to 1.27 to 1.12 kg per day; and at about 780 kg, as the steer gets closer to its mature weight, the rate of gain per day drops to 0.81 kg.

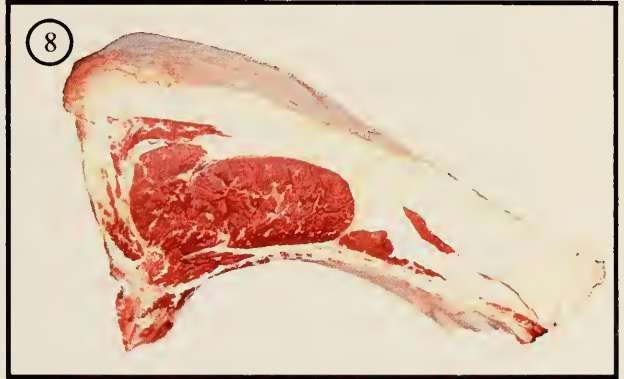
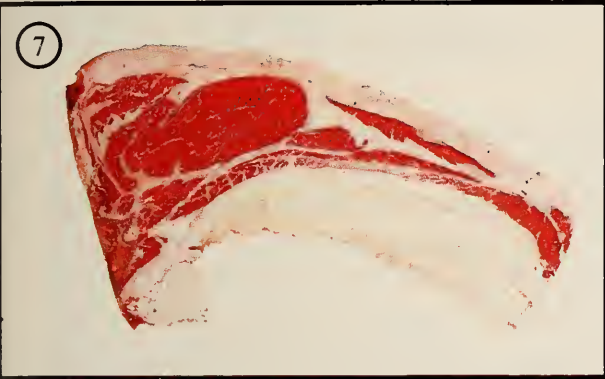
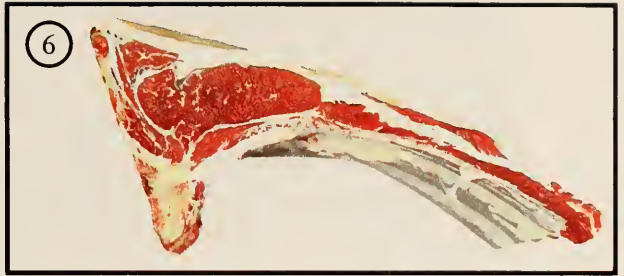
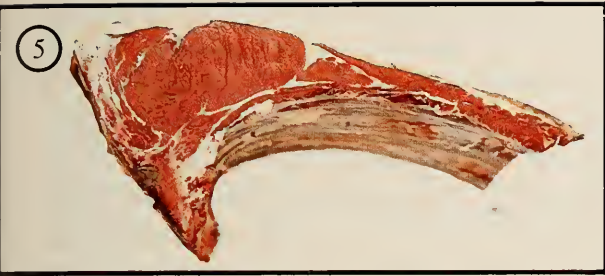
These data for growth rate and feed efficiency are typical for Holstein steers maintained at a high level of nutrition from birth to slaughter. For steers raised entirely on forages (range, pasture, hay, or silage) the gains are lower and the units of feed per unit of gain higher. When range- or forage-fed steers are changed to a high-energy grain ration, rates of gain as high as 1.5 kg per day and higher are not unusual or unexpected.

As mentioned previously, there are various ways of buying and raising Holstein calves. The calves that are not slaughtered for veal are grown to more mature weights for beef production. Once the decision has been made to finish dairy steers to beef weights, the grower–finisher must keep in mind what the market or meat packer wants in a finished steer. The steer must produce a carcass that weighs from 250 to 317 kg, with sufficient finish or fat (4–14 mm) to reach the A1 or A2 grade. Therefore, live-body weights must be 435–550 kg, depending on the degree of finish they are carrying. Underfinished and overfinished animals are priced lower, even if they are within the desired weight range. Conversely, carcasses lighter than 250 kg or heavier than 317 kg are discounted, even though they carry sufficient fat to grade A1 or A2.

Carcass changes during growth

As an animal grows, the composition of gain changes. A young calf initially demonstrates rapid bone growth. As it gets a little older, it begins a rapid deposition of lean meat, and finally in the later stages of growth, a preponderance of fat is added to the carcass. After maintenance requirements have been met, excess feed consumed is used for the growth of bone, muscle, and fat. If the animal is fed on a low-energy ration such as rangeland, appreciable fattening will not occur until the animal approaches maturity. However, fattening begins much earlier if the animal consumes large amounts of high-energy feed such as cereals or corn. This is





Carcasses and rib cuts from Holstein steers slaughtered at four different slaughter weights

- Fig. 1 Carcass sides from a Holstein steer slaughtered at 385 kg.
- Fig. 2 Carcass sides from a Holstein steer slaughtered at 522 kg.
- Fig. 3 Carcass sides from a Holstein steer slaughtered at 703 kg.
- Fig. 4 Carcass sides from a Holstein steer slaughtered at 840 kg.
- Fig. 5 Carcass 11th rib face from a Holstein steer slaughtered at 385 kg.
- Fig. 6 Carcass 11th rib face from a Holstein steer slaughtered at 522 kg.
- Fig. 7 Carcass 11th rib face from a Holstein steer slaughtered at 703 kg.
- Fig. 8 Carcass 11th rib face from a Holstein steer slaughtered at 840 kg.

evident in the data presented in Table 3, where the animals received up to 64% of their rations in the form of concentrate. With this feeding regimen, the steers had enough fat cover to reach the A1 grade when they were just over 9 months old and weighed 339 kg. However, the meat packers would have discounted these steers because their carcasses were only 173 kg. At 14.5 months of age, when the steers had carcasses averaging 277 kg, they were fully acceptable and most would have been graded A2. (The price paid by the industry is the same for A1 or A2 carcasses in the correct weight range.) By 20 months, the carcasses were overweight and overly fat (A3 grade). The steers continued to increase the proportion of carcass fat and were graded A4 when the final group was slaughtered at about 27.5 months of age and 802 kg liveweight.

From an economic point of view, it is not practical to raise Holstein steers on a high-energy ration beyond about 600 kg liveweight. At this stage, they would be overly fat and their carcasses would be subjected to a penalty because they weighed more than 315 kg each. However, this experiment was carried out to show that the Holstein breed can be fed to produce excessively fat carcasses and heavily marbled meat (as can beef breeds) but it must be raised to higher slaughter weights than comparable beef animals. The marbling, or percentage of fat (ether extract), of the rib eye increased from 0.9 to 15.2% while the animal grew from 165 to 802 kg, and over this same period of growth the kidney fat increased from 2.4 to 61.4 kg. Similarly, rib fat increased from 7.6 to 43.0%, whereas the proportion of lean

Table 3. Carcass characteristics of steers from 161 to 835 kg final slaughter weight.

	Slaughter weight groups				
	1	2	3	4	5
Age when slaughtered (days)	154	285	447	611	835
Live slaughter weight (kg)	161	339	520	704	835
Shrunk slaughter weight (kg)	149	311	485	668	802
Live shrink (%)	7.5	8.3	6.7	5.1	4.0
Hot carcass weight (kg)	83	173	277	392	486
Dressing (%)	55.7	55.6	57.1	58.7	60.6
Cold carcass weight (kg)	80	171	274	389	482
Carcass shrink (%)	3.6	1.2	1.1	0.80	0.82
Hindquarter (%)	50.3	49.9	49.0	47.2	45.7
Kidney fat (kg)	2.4	2.6	8.6	21.2	61.4
9th–11th rib composition (%)					
bone	24.5	19.5	15.4	14.0	12.4
fat	7.6	20.8	31.5	41.2	43.0
lean	67.9	59.7	53.1	44.8	44.6
Marbling (%)*	0.9	2.9	5.5	9.2	15.2
Rib fat depth (mm)	—	7.0	13.9	23.6	39.1
Carcass grade	—	A1	A2	A3	A4

* Ether extract of the *longissimus dorsi* (rib eye) muscle.

dropped from 67.9 to 44.6% and the percentage of bone decreased by 50%, from 24.5 to 12.4%. Characteristically, as these Holstein steers fattened and matured, the percentage of live and carcass shrink and the carcass hindquarters decreased while the dressing percentage increased. This experiment led to the conclusion that when Holstein steers are grown and finished at a relatively high standard of nutrition, the ideal final weight is 500 kg. Steers raised at a lower standard of nutrition are heavier and require a longer finishing period to reach the same degree of finish.

Effect of hormone implants

During the mid 1950s and continuing through the 1960s and 1970s, the synthetic anabolic hormone diethylstilbestrol (DES) gained wide popularity for its growth-promoting ability. It can be administered to cattle orally or implanted subcutaneously, in the ear. The effect of DES treatment was to improve rate and efficiency of gain primarily in the feedlot, and it often tended to increase daily feed consumption. The way in which DES achieves this improvement is not known, but the final result is to delay the fat and increase the protein deposition in the steer. However, DES has been shown to have carcinogenic properties, and consequently it has been banned for use as a growth promoter. Other anabolic and antibiotic compounds that are noncarcinogenic and produce the same effect are currently available on the market.

Two natural female anabolic hormones and a chemical have been authorized for use on steers in Canada for a number of years. These are Synovex-S® or Steeroid® (progesterone plus estradiol) and Ralgro® (zeranol). A third compound, Compudose® (estradiol 17 beta), which is purported to have a much longer lasting effect than other estradiol implants, was released for use in Canada in 1984. When added to the ration, the sodium ionophores Rumensin® (monensin sodium) and Bovatec® (lasalocid) also improve the rate or efficiency of gain, or both, presumably through a different mechanism, such as altering rumen conditions. Three other ionophores, Avoparcin,® Narasin,® and Salinomycin,® are being tested (1985) to see if they also have growth-promoting abilities.

Another combination implant, Synovex-H® (containing estradiol and testosterone), is recommended for improving rate and efficiency of gain of heifers. Testosterone is the natural male sex hormone. One additional compound, melengestrol acetate, improves the performance of feedlot heifers by suppressing heat periods.

The hormone implant Synovex-S® was shown to be effective in improving growth and efficiency in Holstein steers at liveweights ranging from 181 to 726 kg (Table 4). The percentage improvement in rate of gain continued to increase from 13.8% at 181 kg to 42.5% at 726 kg. However, the most effective period for improvement of total rate of gain occurred at 362 kg, where the maximum rate of gain increased from 1.08 to 1.42 kg per day. At this stage, the improvement in feed efficiency was the highest (24.1%) of the four test groups. At higher or lower weights, improvement in feed efficiency was less (9.4 to 18.2%).

In another experiment, a concentrate-sparing effect (replacement of concentrate with hay) was demonstrated from implanting Holstein steers with hormones (Table 5). During a 167-day feeding period, the all-concentrate control group

Table 4. Effect of hormone implants administered at various weights on growth and feed efficiency of Holstein steers.

Implant weight (kg)	Treatment	Gain per day (kg)	Change (%)	Feed efficiency (kg feed per kg gain)	Change (%)
181	none	1.15	13.8	4.76	9.4
	implant	1.31		4.35	
362	none	1.08	31.5	7.01	24.1
	implant	1.42		5.65	
544	none	0.96	33.1	8.35	17.1
	implant	1.28		6.92	
726	none	0.81	42.5	9.69	18.2
	implant	1.15		7.93	

consumed 1500 kg of concentrate and gained 197 kg. The implanted group consumed 1040 kg of hay and 749 kg of concentrate and gained 200 kg. The control and implant groups yielded cold carcasses weighing 263 and 255 kg, respectively. Assuming that hay costs \$100/tonne and concentrate \$200/tonne, the cost to produce a kilogram of carcass was \$1.14 for the control group and \$1.00 for the implanted group, representing a saving of \$44.00 per animal for an approximate cost of \$3.00 per implant.

All-concentrate feeding

Before the 1950s, it was believed that roughage, such as hay or grass, had to be included in the ruminant ration possibly because it contains essential unknown nutrients. Numerous experiments with all-concentrate feeding carried out since the 1950s have shown that this need for roughage is essentially physical rather than chemical in nature. A ration consisting of rolled barley and a complete supplement or a mixed ration with a vitamin supplement (Table 1) sustains a high rate of growth in Holstein steers. It is important that the grains in an all-concentrate ration be rolled rather than ground to satisfy the roughage requirement for the proper functioning of the bovine stomach. If ground grains are used in the concentrate, a portion of the ration must consist of roughage to ensure the proper functioning of the rumen. The inclusion of roughage also tends to reduce the incidence of bloat. Therefore, the feeding of all-concentrate rations for producing dairy beef is recommended only under specialized circumstances, when the necessary amount

Table 5. Concentrate-sparing effects of hormone implants.

	No treatment	Hormone implant
Days in feedlot	167	167
Hay consumed (kg)	—	1040
Concentrate consumed (kg)	1500	749
Weight change (kg)	197	200
Shrunk slaughter weight (kg)	500	501
Cold carcass weight (kg)	263	255
Rib fat depth (mm)	14.0	12.5
Carcass grade	A2	A2
Feed costs per kg carcass*	\$1.14	\$1.00

* Assuming that hay costs \$100 and concentrate \$200 per tonne.

of time can be spent in caring for and observing the steers. It should be noted that maximum gains can still be obtained if 20% of the ration consists of roughage, and fewer digestive problems are encountered than when all-concentrate rations are fed. Rates of gain are reduced only when the proportion of high-quality roughage is increased to the stage where the energy intake is limited because of the physical capacity of the rumen. If low-quality roughage is used, the limit will be reached earlier, since this material requires a longer period for digestion in the rumen.

An experiment was designed to compare the effects of implanting steers raised on an all-concentrate ration (Table 6). Steers were given 160 kg of whole milk during their first 8 weeks and ad libitum concentrate (Table 1) until they were slaughtered at 476 kg. The implanted steers reached slaughter weight 26 days earlier than the control group. They also gained 6.8% faster, consumed 8.7% less feed, and were 9.3% more efficient than the control group when compared over the whole growth period from birth to slaughter. During the actual treatment period from 340 to 476 kg (when the implant was operative) these effects were higher, ranging from 18.7 to 26.0%. The control steers had 14.3% more fat, 4% less bone, and 8.8% less lean in their rib sections than the implanted group. This illustrates that the major effect of the hormone is to decrease or delay fat deposition and increase the proportion of bone and lean in the carcass. It is not surprising, then, that the feed efficiency is improved, because a kilogram of lean consists of 25% solids, and fat consists of about 85% solids, with the remainder made up of water. In addition, fat has 2.25 times the energy content as lean. Thus, a kilogram of fat contains about 7.6 times as much energy as a kilogram of lean.

Since the major effect of the implanted hormone is to delay the fat-deposition stage, it would be expected that the most effective time to implant Holsteins is when they are gaining weight rapidly, are being full fed on a high-energy ration, and are well into the fattening or finishing stage. At other growth stages and nutrition levels, the implant treatment would be expected to be less effective or even cause no response whatever. It is questionable whether repeated implants of hormones throughout the growth phase are any more effective than a single treatment at the appropriate stage of growth and maturity.

Table 6. Comparison of all-concentrate-fed steers with and without a hormone implant.

	Control steers	Implanted steers	Difference (%)
Birth weight (kg)	45	47	
Shrunk slaughter weight (kg)	475	477	
Total weight gain (kg)	430	430	
Whole milk consumed (kg)	160	160	
Age when slaughtered (days)	417	391	
Rate of gain (kg/day)			
implant period*	1.00	1.26	26.0
birth to slaughter	1.03	1.10	6.8
Concentrate consumed (kg)			
implant period*	2481	2016	18.7
birth to slaughter	5337	4872	8.7
Feed efficiency (kg feed/kg gain)			
implant period*	8.29	6.70	23.7
birth to slaughter	5.62	5.14	9.3
Carcass grade	A2	A2	
9th–11th rib composition (%)			
bone	17.8	18.3	4.0
fat	33.6	28.8	14.3
lean	48.6	52.9	8.8

* From the 340-kg implant weight to slaughter at 476 kg.

Holstein bulls for beef production

It is well established that bulls grow faster than steers, which in turn grow faster than heifers. It is also known that heifers mature and fatten earlier than steers, which in turn fatten sooner than bulls. It would seem logical then to investigate this faster growing characteristic of the uncastrated male Holstein to see if it can be used to produce more economical beef without loss of quality.

Holstein-Friesian male calves were placed on test at birth and fed 150 kg of whole milk. One-half of the group was castrated at 4 weeks of age, providing 18 steers and 18 bulls (Table 7). Starting from the first week and continuing until slaughter at 452 kg, the animals were full fed an all-concentrate ration (Table 1). The starter ration was replaced by the grower–finisher when the calves were 135 kg. The bulls reached slaughter weight 53 days earlier than the steers. They also gained 15.5% faster, consumed 13.8% less concentrate, and were 14.2% more efficient than the steers. The steers had 32.7% more fat, 20.2% less lean, and 6.3% less bone in their rib sections than the bulls. On the basis of the depth of back-fat thickness on the rib section of the carcass, the steers would have averaged an A2 grade and the bulls A1. This experiment showed that bulls produced beef more economically

Table 7. Comparison of Holstein steers and bulls reared on an all-concentrate ration.

	Steers	Bulls	Difference (%)
Number of animals	18	18	—
Birth weight (kg)	45.4	45.4	—
Shrunk slaughter weight (kg)	452	452	—
Age when slaughtered (days)	417	364	—
Gain per day (kg)	1.03	1.19	15.5
Total concentrate (kg)	2420	2087	13.8
Kg concentrate per kg gain	5.62	4.82	14.2
Hot carcass (kg)	259	260	0.4
Dressing (%)	57.3	57.5	0.3
Rib fat depth (mm)	14.4	10.0	30.6
Carcass grade	A2	A1	—
9th–11th rib composition (%)			
bone	17.8	19.0	6.3
fat	33.6	22.6	32.7
lean	48.6	58.4	20.2

than did steers. Because the bulls were only a year old at slaughter, they were not difficult to handle and did not show the pronounced neck development characteristic of more mature bulls. None of the carcasses had dark-cutting or dark-colored meat instead of bright red. Experience has shown that groups of bulls that have been together for a significant period of time and have an established bunting order are not usually difficult to control, nor do they produce dark-cutting meat when sent to slaughter. If strange bulls are brought together shortly before or on the way to slaughter, they may fight, with the result that a large proportion of them have dark-colored lean meat, which disqualifies them from the top grades.

Roasts from the bulls and steers in this experiment were evaluated by a trained scientific taste panel. The results indicated that meat from either group was fully acceptable. The consumer would not be able to distinguish bull meat from steer meat in this experiment. All of the 36 bulls used in this experiment were marketed locally without a single complaint registered. Obviously, if bulls are fed properly and slaughtered at a youthful growth stage, they can produce beef of a quality similar to steer beef at less cost. In spite of these findings, the beef industry is still resisting bull beef, discriminating against it without valid reason. Obviously, more education and further applied research are required on various aspects of bull beef production before it can be recommended universally.

In another experiment the effect of implanting bulls was also investigated. There was only a very slight, insignificant improvement in the rate and efficiency of gain. However, the hormone treatment tended to increase rather than decrease fat deposition, which is opposite to the effect hormones have on steers. This aspect of beef production also requires further scientific investigation. It would be of value to have bulls begin depositing fat at an earlier stage without sacrificing rate of gain or efficiency, as was the case in this experiment.

Comparison of Holstein-Friesian and Hereford steers

Over the years, beef industry personnel have maintained that meat from dairy breeds is inferior to meat produced by beef breeds. They claim that dairy beef lacks quality in taste, flavor, and tenderness, and that it falls short of the beef breeds in yield of salable beef from the carcass because of conformational differences. Even today, meat packers downgrade and pay less for carcasses from dairy steers. They label dairy beef with an A1X grade, even if Agriculture Canada graders pass it as A1 beef, the top grade in the Canadian grading system. To a large measure, however, the lower price paid for dairy carcasses is compensated for by the fact that dairy feeders can be purchased for less than beef feeders. The growth of centralized meat-cutting and the marketing of boxed beef should contribute to the elimination of industry discrimination based on conformational differences between beef and dairy steers. From the point of view of quality, retail dairy beef is indistinguishable from beef from the established beef breeds.

The carcass qualities of Holstein and Hereford steers have been compared at the Lennoxville and Agassiz research stations. In the Lennoxville experiment, the steers were fed a medium-energy ration and were slaughtered when the Holsteins and Herefords reached 543 and 443 kg, respectively (Table 8). At this stage, there was less than 1% difference in the fat content of their 12th rib sections. However, Holsteins had almost three times as much kidney fat (181.4%) and 3.7 mm (29.1%) less fat in their rib sections. Holsteins should be slaughtered at minimum back-fat levels to compete economically with a beef breed such as Hereford. Lowering the fat-level requirements of the Canadian carcass-quality system would result in a greater benefit for dairy beef carcasses.

The Agassiz Research Station compared Holstein and Hereford carcasses from a different point of view. It has already been demonstrated that the Holstein-Friesian fattens excessively in both subcutaneous and intramuscular (marbling) fat (see Table 8), provided it is fed a high-energy ration or raised to weights of over 600 kg. Therefore, a number of carcass characteristics of Holsteins fed high-energy rations were compared with Herefords fed medium-energy rations. The animals

Table 8. Comparative carcass characteristics of Holstein and Hereford steers fed a moderate-energy ration.

	Holstein	Hereford	Difference (%)
Final live weight (kg)	543	443	22.6
Hot carcass weight (kg)	292	235	24.3
Dressing (%)	54.4	54.5	0.2
Kidney fat (kg)	16.6	5.9	181.4
Rib eye area (mm ²)	64.2	62.0	3.5
Rib fat depth (mm)	8.4	12.1	29.1
12th rib composition (%)			
bone	17.4	15.9	9.4
fat	26.0	26.2	0.8
lean	55.9	57.1	2.1

were slaughtered at similar final weights, when both breeds had the same percentage of fat in the rib section (Table 9).

When Holstein and Hereford steers were subjected to a 24-hour shrink period (without food or water) Holsteins shrank 3.3% more, dressed out at 2% less, and had 0.5% more carcass hindquarter than Herefords (Table 9). The two breeds differed substantially in offal fat, with the Holsteins having 54.2 and 19.4% more abdominal and kidney fat, respectively. However, there was less than 0.2% difference in proportions of bone, fat, and lean in the rib sections of the two breeds. In total carcass composition, the Holsteins had 1.3% more bone, 1.6% less fat, and 0.3% more lean than the Herefords. The Herefords had more subcutaneous fat in the rib section than did the Holsteins, and the majority of animals in both breeds attained the A1 grade.

These experiments have highlighted several salient differences and similarities between the Holstein-Friesian and Hereford breeds. It is evident that the Holstein shrinks more, has more offal and waste fat, and dresses lower than the Hereford. On the other hand, both breeds have essentially the same proportion of carcass lean and the same final grades. Therefore, there should be no differences in rail grade prices between the two breeds, but the Holstein should be discounted if purchased on a live or live-shrunk basis. Assuming that the rail grade price of beef is \$3.30/kg (Table 9) it can be extrapolated that the live full-weight price will be \$1.63 and \$1.75/kg and the live-shrunk price \$1.78 and \$1.84/kg for the Holstein and Hereford breeds, respectively. Therefore, a fair price differential between the Hereford and Holsteins would be zero, 3.3, and 6.9% if the animals are purchased on a rail, live-shrunk, and live-full basis, respectively.

Table 9. Comparative carcass characteristics of Holsteins and Herefords.

	Holstein	Hereford	Difference (%)
Final slaughter weight (kg)	430	437	1.6
Shrunk slaughter weight (kg)	392	414	5.3
Live shrink (%)	8.8	5.3	3.3
Hot carcass weight (kg)	214	235	8.9
Dressing (%)	54.7	56.7	2.0
Hindquarter (%)	48.3	47.8	0.5
Abdominal fat (kg)	7.2	3.3	54.2
Kidney fat (kg)	5.7	4.3	19.4
9th–11th rib composition (%)			
bone	19.3	19.2	0.1
fat	22.7	22.7	0.0
lean	58.0	58.1	0.1
Total carcass composition (%)			
bone	13.0	11.7	1.3
fat	17.0	18.6	1.6
lean	70.0	69.7	0.3
Rib fat depth (mm)	7.8	9.1	14.2
Carcass grade	A1	A1	—

CONCLUSIONS

Holstein-Friesian steers can produce beef of excellent quality if the animals are subjected to conventional growing, finishing, and raising methods. Implanting them with hormones improves the rate and efficiency of gain by reducing the fat deposition without sacrificing beef quality and provides additional profit for the finisher. Bulls can produce beef more economically in rate and efficiency of gain, but they are subject to market discrimination. Holsteins shrink more, deposit more internal fat, and dress lower than Herefords, but the carcass price paid for both breeds should be the same if they receive identical rail grades.

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APPENDIX

REGIMEN FOR RAISING DAIRY STEERS

Dairy steers can be put on different types of rations after they reach the weight of 130 kg. The goal should be a gain of approximately 1 kg per day. A daily allowance of at least 2 kg of concentrate must be provided to maintain the desired growth and to reach slaughter at about 18 months of age. Dairy steers can feed on pasture during the summer. Forages of excellent quality provide the basis of economical rations during the growth phase of dairy steers. Grain is needed to raise the energy in the diet to ensure continuous growth.

Feeding between 2 and 3 kg of grain per day to spring-born calves on a good pasture results in daily gains of about a kilogram. Research at Lennoxville has shown that the most efficient use of grass and meal was reached when 2 kg of meal per head per day was fed as opposed to 1 or 3 kg. Feed conversion improved by 25% or more for the 2-kg group than for the 1- or 3-kg groups. Thus, feeding grain *ad libitum* to young, growing calves on pasture is not recommended because the extra gain is not economical.

During the first winter, calves should be fed all the good-quality forage they can eat, plus 2.2 kg of grain per day. Usually, the dairy steer benefits from only one pasture season. When the steer surpasses the live-body weight of 300 kg, the daily concentrate allowance can be doubled to increase daily gains and start the fattening process. At that point, rations should be made up of high-energy feeds such as corn silage, cereal grain silage, high-moisture corn, dry-grain corn, barley, and culled potatoes. Finally, during the fattening phase (400–500 kg), the ration may consist of grains only.

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